INSTRUCTIONS

SECTIONALIZED CAMSHAFTS
GENERAL ELECTRIC DIESEL ENGINES

CONTENTS

	Page
DESCRIPTION	
CAMSHAFTS	1
SUPPORT BEARINGS	2
THRUST BEARINGS	2
DRIVE GEARS	2
REMOVING CAMSHAFT BEARINGS	3
REMOVING CAMSHAFTS	3
REPAIRING CAMSHAFT SECTIONS	5
CHECKING BEARING CLEARANCE	5
BALANCE SHAFTS — 8 CYLINDER ENGINES	6
REMOVING GEARS AND THRUST BEARINGS	6
REASSEMBLING GEARS AND THRUST BEARINGS	6
CAMSHAFT TIMING	6
DATA	8
TORQUE VALUES	8

DESCRIPTION

CAMSHAFTS

Two sectionalized camshafts, one mounted in each side of the engine frame, are driven by gearing directly from the crankshaft. Both camshafts rotate in the same direction, opposite to the crankshaft rotation, and at one-half the crankshaft speed.

Each sectionalized camshaft is made up of individual precision-machined sections which are fastened together by threaded dowels and nuts. See Figs. 1 and 4. The intake, fuel, and exhaust cams are integral parts of each hollow section. The journal and cam sections are treated to provide hardened wear surfaces.

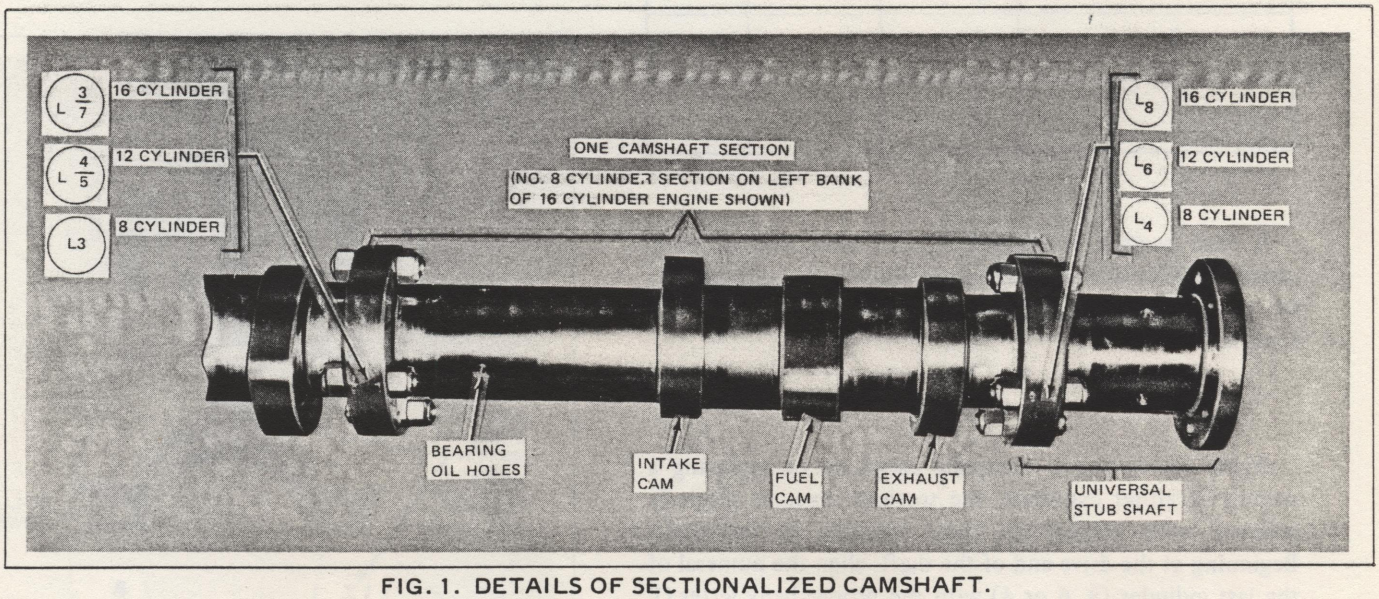

FIG. 1. DETAILS OF SECTIONALIZED CAMSHAFT.

FIG. 1, E-16168A

These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the General Electric Company.

Verify numbers for parts, tools, or material by using the Renewal Parts or Tool Catalogs, or contact your General Electric representative for assistance. Do not order from this publication.

GENERAL ELECTRIC

The sections containing the cams are stamped with the letters L (left) or R (right) on the edge of the forward flange. This identifies their location with respect to the left or right banks of the engine. The edge of the other flange is stamped with numbers (see Table I) which are used to properly index the section's position in the shaft with respect to the corresponding cylinder. These sections are interchangeable within their respective camshafts but, because of the reversal between the inlet and exhaust cams, they are not interchangeable between the left and right bank camshafts.

TABLE I, CAMSHAFT MARKINGS

Cylinder Location (Right or Left Bank)	Engine Model		
	16 Cyl.	12 Cyl.	8 Cyl.
8	8		
7	$\frac{3}{7}$		
6	6	6	
5	$\frac{1}{5}$	$\frac{4}{5}$	
4	4	$\frac{4}{5}$	4
3	$\frac{3}{7}$	3	3
2	2	$\frac{1}{2}$	2
1	$\frac{1}{5}$	$\frac{1}{2}$	1

A stub section is located at the drive end of each camshaft. This is a universal piece which may be assembled, by proper indexing, to either the left or right bank camshaft.

When assembling a complete camshaft or replacing a section of either camshaft, the sections must be properly indexed with respect to their location in the shaft. Beginning at the drive end of the shaft, align the numeral of the last cylinder (8, 6 or 4) with the proper bank letter (L or R) on the stub section and bolt them together. Rotate the shaft so the bank letter on this section is plainly visible, and align the numeral for the next cylinder (e.g., 7 marked $\frac{3}{7}$ as shown in Fig. 1) next to the bank letter. Bolt this section to the previous one and proceed to the next section in a like manner, until the free end of the engine is reached. See Table I for proper numerical markings.

NOTE: *Camshaft sections are not interchangeable between two different sized engines.*

A cover bolted over the end of the free-end camshaft section closes the end of the central oil passage in the shaft.

SUPPORT BEARINGS (See Fig. 2)

Removable aluminum-alloy split bearings support each shaft within the engine frame in the line-bored bearing seats. The bearings are held in place by bolts extending from outside the engine frame into tapped holes in the bearings. The tapped holes are reinforced by helical steel thread inserts.

The two bearing halves are aligned by hollow steel dowels and are held together by bolts threaded into the steel thread inserts. The two bearing halves are match-marked with numerals and should always be installed as a set. The bearings may be removed from the engine for inspection or replacement without disturbing the camshaft.

THRUST BEARINGS

A thrust bearing assembly, located next to the drive gear on each camshaft, controls the longitudinal shaft movement. A steel thrust ring, positioned by a dowel, is locate

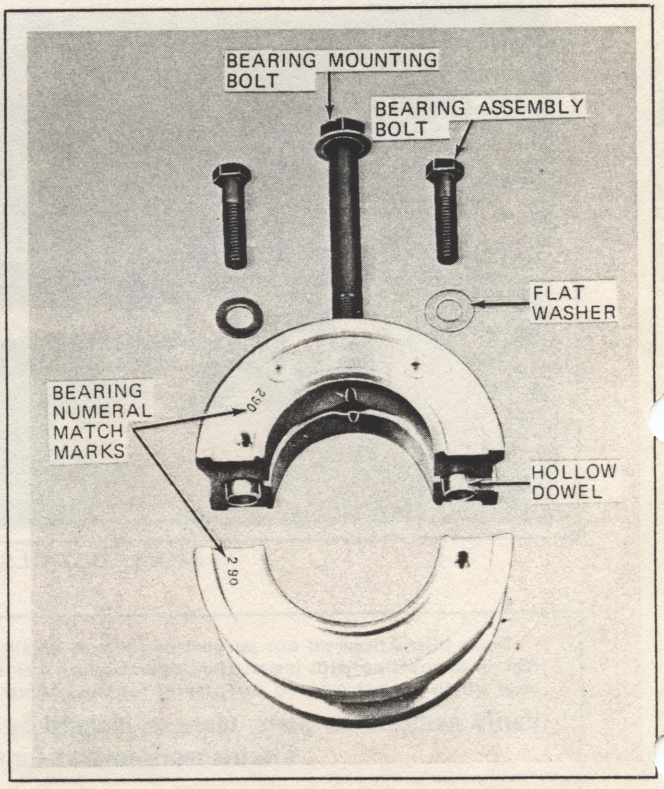

FIG. 2, E-13239

FIG. 2. CAMSHAFT BEARING ASSEMBLY.

between the camshaft flange and the drive gear. A semi-circular, grooved bearing is bolted to the engine frame and fits over the thrust ring to restrict the longitudinal travel (See Fig. 3).

By properly positioning the drive gears, the thrust bearing bolts may be removed through holes in the gear webs without removing the drive gears.

FIG. 3, E-13320

DRIVE GEARS

The drive gears and thrust rings are bolted together and to the camshaft drive flange. An indexing dowel in the hub of each gear correctly positions the timing dots on the gear with respect to its camshaft. The timing dots are located on the side of the gear rim facing the generator-end of the engine.

REMOVING CAMSHAFT BEARINGS

To inspect or renew a camshaft bearing, proceed as follows:

1. Remove the crankcase inspection cover and the bearing mounting bolt which extends through the side of the engine frame.

   If more than one bearing is to be removed, place wooden blocks under the camshaft to support it after the first bearing is removed. If all the bearings are being removed, remove the center bearing first, and work toward both ends.

2. Carefully tap the bearing from its bore with a soft hammer.

3. Remove the bearing assembly bolts, then separate the halves and remove the bearing from the shaft.

CAUTION: *Do not pry bearing halves apart. Instead, while removing the bearing assembly bolts and while the last few threads are still engaged, lightly tap each bolt head to separate the bearing halves.*

To install a bearing, reverse the above procedure. See DATA section for bearing clearances and TORQUE VALUES section for correct bolt torques.

NOTE: *A coat of clean engine crankcase oil on the bearing and its bore will make bearing installation easier.*

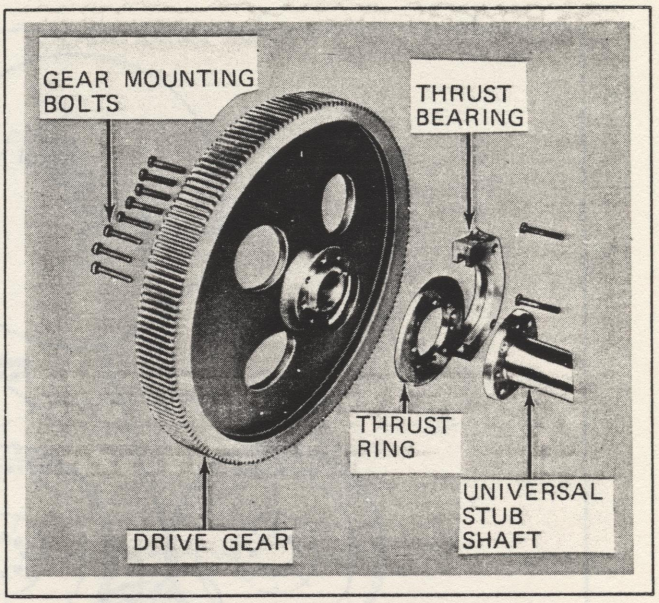

FIG. 3. CAMSHAFT DRIVE AND THRUST BEARING ASSEMBLY.

REMOVING CAMSHAFTS

To renew a single section of the camshaft proceed as follows:

1. Compress the valve springs and release the valve push-rods from their sockets on ALL cylinders in the bank of the engine where a camshaft section is to be removed. Use rocker arm depressor, Part 147X1040-1.

2. Lift the valve and fuel crossheads (on all cylinders in the bank), and lock them up using a locking pin inserted through the hole in the crosshead guide. To raise the fuel crosshead against the pump spring pressure, force a hardwood or fiber wedge between the roller and cam.

3. Bar-over the engine until the index marks on the flanges of cam section to be removed are visible in the crankcase inspection opening.

4. Remove the mounting bolts from the two cam bearings adjacent to the section to be replaced. Then, carefully push the bearings out of their bores in the frame.

5. Loosen the bearing assembly bolts and separate the bearing halves. Use care not to damage the bearing.

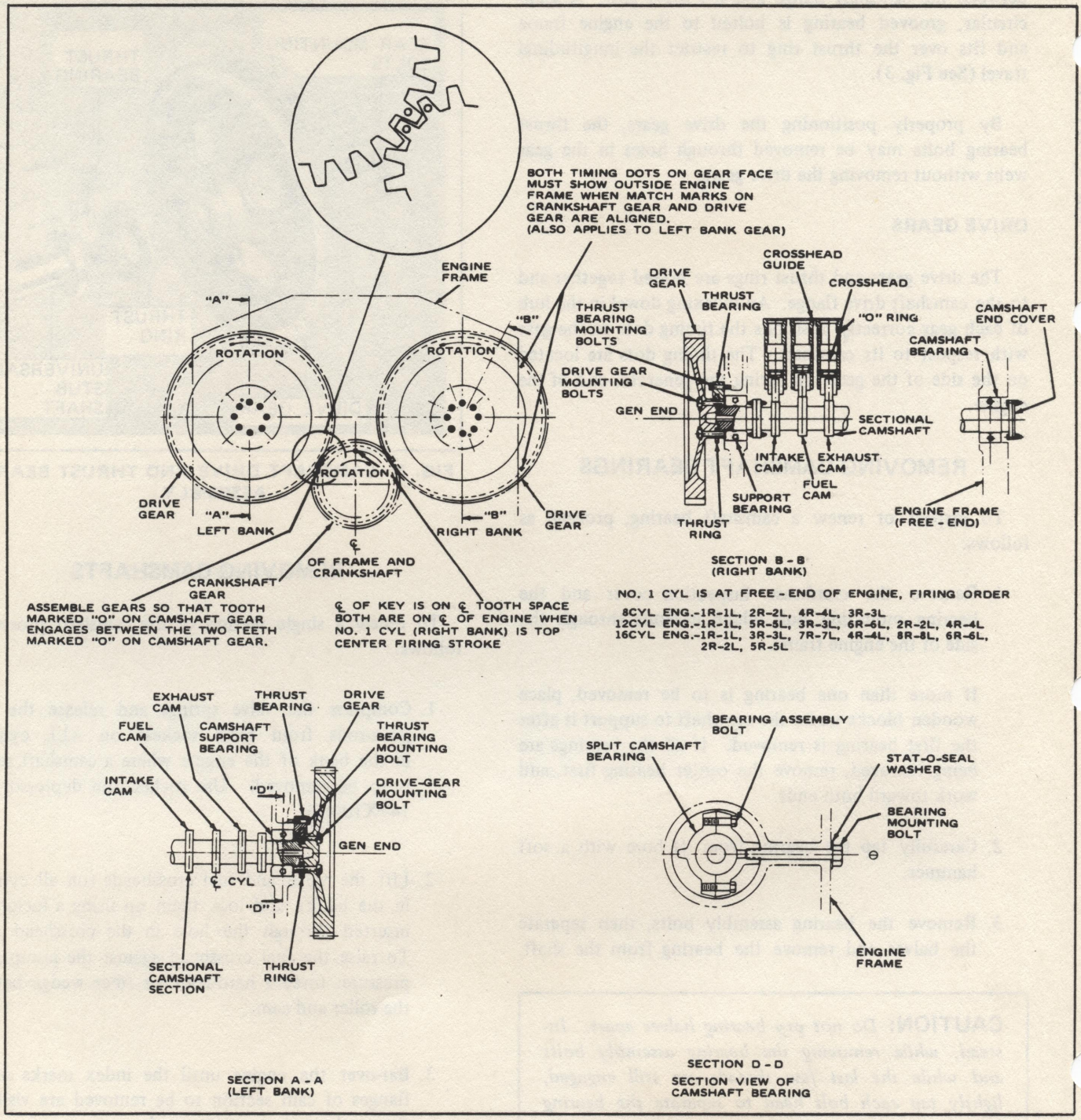

FIG. 4, E-13238A

FIG. 4. CAMSHAFT DRIVE AND ASSEMBLY.

Bearing halves can be separated by not completely removing the bolts, then tapping lightly on the head of the bolts until the bearing has separated from the hollow dowel.

6. Remove the four nuts from the cam section flange toward the driven end of the camshaft. Using a pry-bar placed against a cam and the engine frame, separate the sections. Push the free-end of the shaft towards the free-end of the engine until the opening between the flanges is approximately equal to the width of a cam roller.

7. Remove the remaining four nuts which attach the cam section, and remove the section through the inspection opening.

CAUTION: *For older engines, make sure the correct combination of timing ring, pointer and camshafts is used; for newer engines with barring-over governor drive, correct camshafts and a right-bank camshaft drive gear having timing degree marks must be used. Consult your renewal parts catalog for details.*

8. Install the new section in the reverse of the above sequence. Observe the index markings as previously described. Use special care to keep flanges and pilots clean and free of burrs. Tighten camshaft dowel nuts to 80-90 lb.-ft. of torque. Older style dowels and nuts must be assembled dry. Current production dowels and nuts should be lubricated on the dowel threads and the nut faces with Molykote G-n* lubricant, Part 147X1143-1. Torque to the same value. See Fig. 5 for identifying newer style dowels and nuts.

9. After replacing a camshaft or any section:

   a. Remove the lock pins from all crossheads.

   b. Replace the push rods.

   c. Reset all the valve clearances.

   d. Check the timing on all fuel pumps.

REPAIRING CAMSHAFT SECTIONS

Some camshaft sections can be returned to General Electric for repair. This repair operation includes cleaning, inspection, buffing, dimensional checking, and regrinding the cam-lobe roller surfaces. Only those camshaft sections with wear patterns not exceeding 0.030 in. depth from the ORIGINAL cam-lobe roller surface are repairable.

CHECKING BEARING CLEARANCE

Before removing the bearings, measurements should be made to determine if the bearings must be renewed.

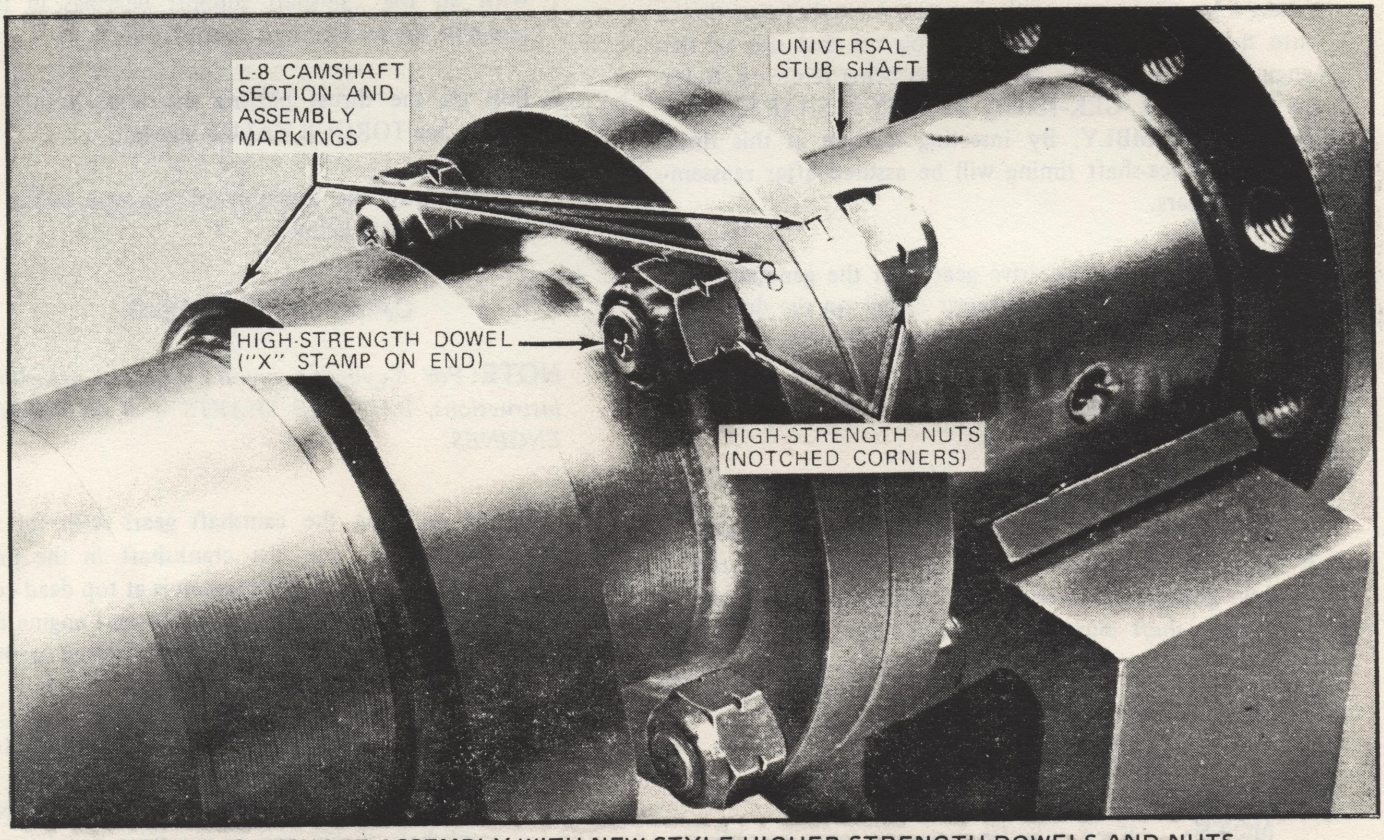
L-8 CAMSHAFT SECTION AND ASSEMBLY MARKINGS
UNIVERSAL STUB SHAFT
HIGH-STRENGTH DOWEL ("X" STAMP ON END)
HIGH-STRENGTH NUTS (NOTCHED CORNERS)

FIG. 5, E-25603

FIG. 5. CAMSHAFT ASSEMBLY WITH NEW STYLE HIGHER STRENGTH DOWELS AND NUTS.

*Product of Dow Corning Corp.

Measure the maximum thrust clearance as follows:

1. Install a dial indicator on the frame, with its tip bearing against the camshaft end or against the side of a cam.

2. Carefully pry the shaft to the limit of its travel in one direction. Set the indicator to zero.

3. Pry the shaft in the opposite direction to the limit of its travel. Compare the dial indicator reading with the thrust limits in DATA section.

Determine the clearance between each camshaft-support bearing and the shaft by inserting a 1/2 in. wide feeler gage of proper thickness. The limits of clearance are listed in DATA section.

BALANCE SHAFTS – 8 CYLINDER ENGINES

The 7FDL8 diesel engines have balance shafts, the gears of which are driven by the drive gears thru idler gears.

Before removing or applying either drive gear, position the No. 1 right bank piston on top-dead-center. Insert a locating pin thru the hole in the main frame down into the balance-shaft alignment hole on that side of the engine from which the drive gear is being removed. Refer to Instructions GEK-18067, BALANCE SHAFTS AND DRIVE ASSEMBLY. By inserting the pin at this time, proper balance-shaft timing will be assured after reassembling the gears.

When removing the drive gear with the generator end cover in place, the rear split-gear clamp on the drive gear must be removed, and the drive gear teeth must be totally disengaged laterally from the teeth on the crankshaft gear and the idler gear before the drive gear can be rolled out of the frame.

CAUTION: *The balance shafts must be timed while timing the camshafts. After assembly of the drive gears, make sure the pins are removed from the balance shaft alignment holes and the frame holes.*

REMOVING GEARS AND THRUST BEARINGS

NOTE: *For 8-cylinder engines, refer to preceding instructions, BALANCE SHAFTS – 8 CYLINDER ENGINES.*

Proceed as follows:

1. Remove the clamping ring from the generator sid of the crankshaft split gear.

2. Remove the mounting bolts from the drive gear.

3. Keeping a firm grip on the gear, pry between the gear and the side frame to work it off the dowel.

CAUTION: *Do not damage the gear teeth.*

4. Remove the bronze thrust bearing.

5. Carefully pry the thrust ring from the shaft flange.

REASSEMBLING GEARS AND THRUST BEARINGS

NOTE: *For 8-cylinder engines, refer to preceding instructions, BALANCE SHAFTS – 8 CYLINDER ENGINES.*

1. With all the camshaft support bearings in place, assemble the thrust ring to the stub section.

2. Bolt on the thrust bearing and lockwire the bolt heads. See TORQUE VALUE section.

3. Proceed with the assembly of the gear to the stub shaft as detailed below.

CAMSHAFT TIMING

NOTE: *For 8-cylinder engines, refer to preceding instructions, BALANCE SHAFTS – 8 CYLINDER ENGINES.*

1. Before engaging the camshaft gears with the split crankshaft gear, put the crankshaft in the proper position (No. 1 right bank piston is at top dead center on the firing stroke) to achieve correct engine firing and firing order. Use one of the following methods:

   a. Use the manual barring-over tool, Part 147X1677, and rotate the crankshaft until the tram gage, Part 147X1230, fits in the hole in the web of the No. 1 crankshaft throw and in the tram depression on the bottom edge of the No. 1 right-side crankcase inspection opening. See Figs. 6 and 7.

FIG. 6, E-20370

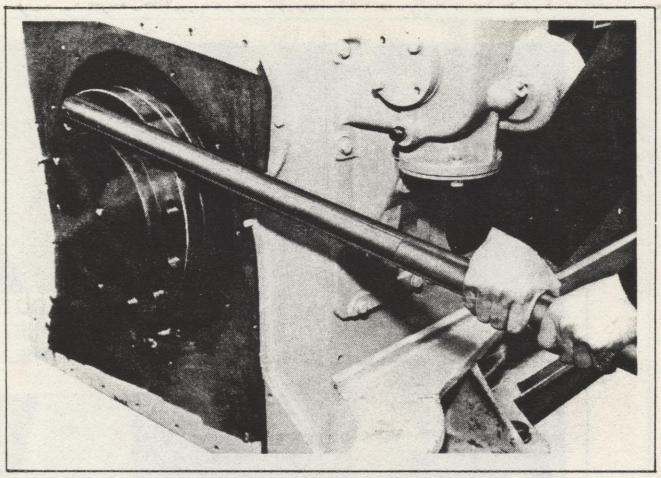

FIG. 6. MANUAL BARRING-OVER TOOL APPLIED TO GENERATOR COUPLING FLANGE HOLES.

b. If the engine is equipped with pointer and timing marks at the forward (free) end of the engine, rotate the crankshaft until the mark 1–8 TDC (16-cylinder engine), 1–6 TDC (12-cylinder engine), on 1–4 TDC (8-cylinder engine) aligns with the right cylinder bank pointer. See Figs. 8, 9 and 10.

NOTE: *If engine is equipped with the current-production governor drive with barring-over feature it is mandatory to use method "a" above.*

2. After the crankshaft has been correctly positioned, install the drive gears. Align the drive-gear timing dots as shown in Figs. 4 and 11. Rotate each camshaft to align the indexing dowel hole with the indexing dowel on each drive gear. Mesh each drive gear with the crankshaft gear and slide them toward the camshaft.

FIG. 7, E-10025

FIG. 8, E-14958

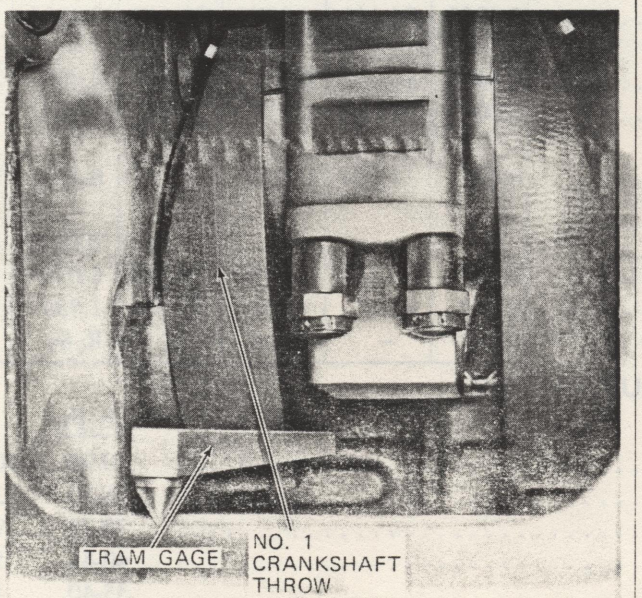

FIG. 7. POSITIONING CRANKSHAFT WITH TRAM GAGE.

FIG. 9, E-13236

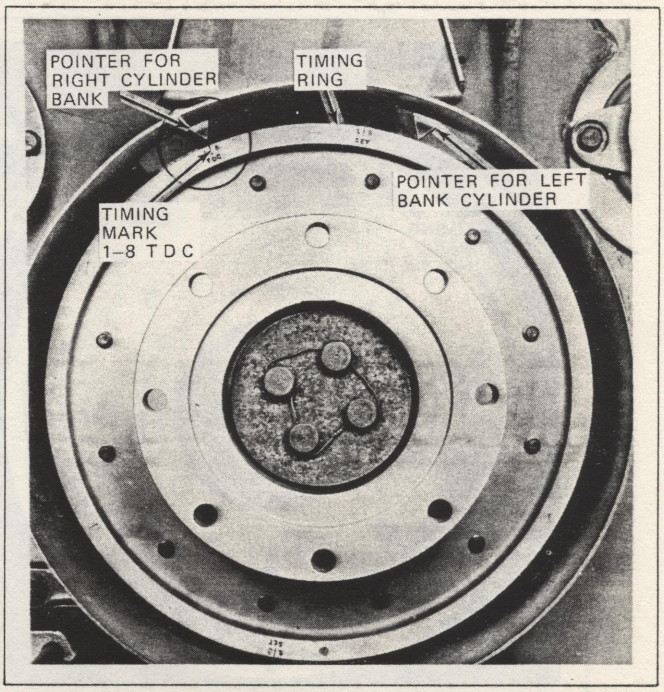

FIG. 8. POSITION OF CRANKSHAFT FOR CAMSHAFT TIMING, 16-CYLINDER ENGINE.

3. Install the drive gear mounting bolts, and torque per TORQUE VALUE section.

NOTE: *Both timing dots on both drive gears must be visible outside of the engine frame (See Fig. 11). If these dots are not visible, with No. 1 right piston at firing top-dead-center, timing is in error and must be corrected.*

4. Check thrust-bearing end clearance.

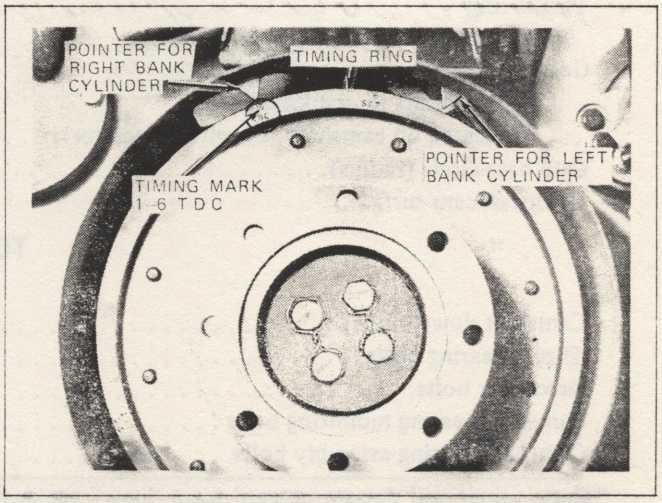

FIG. 9. POSITION OF CRANKSHAFT FOR CAMSHAFT TIMING, 12-CYLINDER ENGINE.

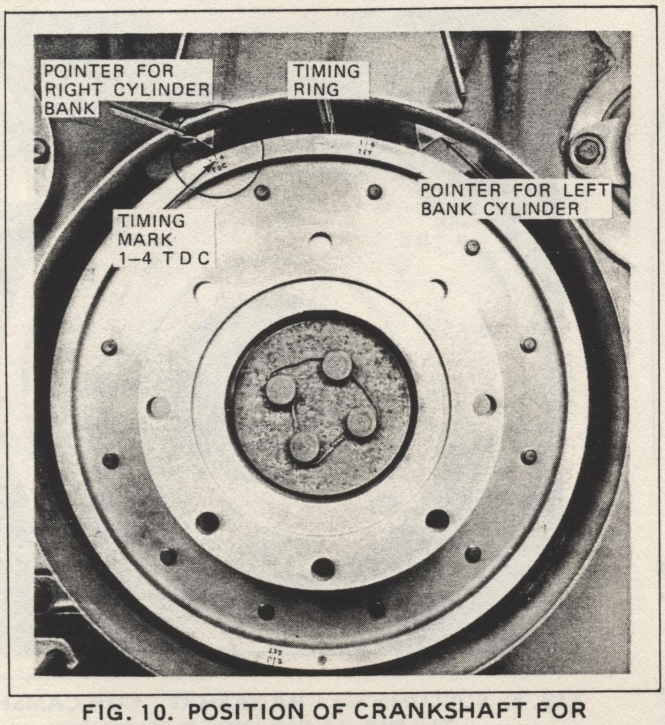

FIG. 10. POSITION OF CRANKSHAFT FOR CAMSHAFT TIMING, 8-CYLINDER ENGINE.

FIG. 10, E-9987

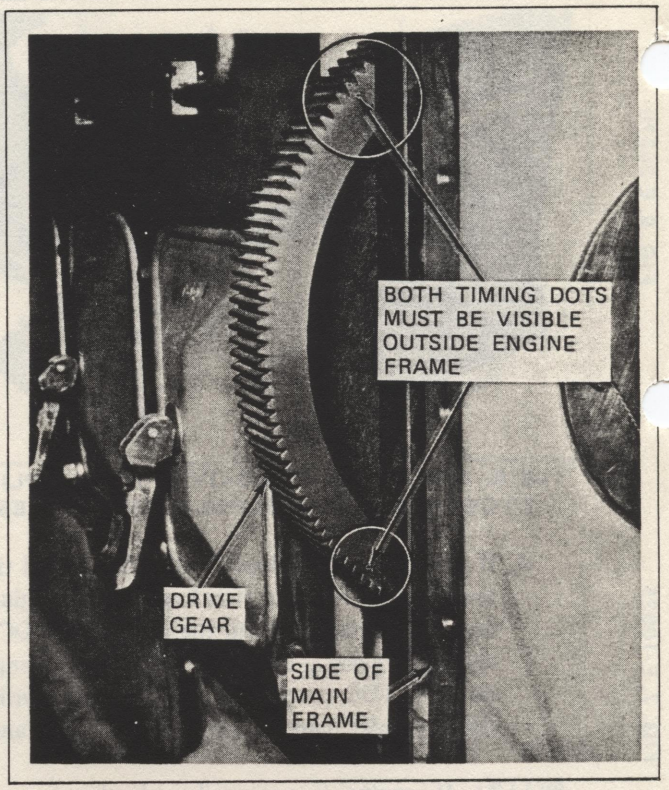

FIG. 11. POSITIONING CAMSHAFT AND GEAR FOR TIMING.

FIG. 11, E-9986

5. Reassemble the clamp ring to the generator side of the crankshaft split gear.

DATA

	Min. New		Max. New		Worn Limit	
	in.	mm	in.	mm	in.	mm
Camshaft bearing						
Bore	3.001	76,225	3.002	76,251	3.0035	76,289
Running clearance with camshaft	0.0035	0,089	0.0055	0,140	0.008	0,203
Camshaft						
Bearing journal diameter	2.9965	76,111	2.9975	76,137	2.9955	76,086
Thrust bearing						
Groove width	0.442	11,227	0.451	11,455	0.453	11,506
End clearance	0.004	0,102	0.015	0,381	0.020	0,508
Thrust ring						
Thickness	0.436	11,074	0.438	11,125	0.433	10,998
Gear backlash						
Camshaft gears to crankshaft gear (indicated on camshaft gear pitch diameter)	0.0086	0,218	0.030	0,762	0.0025-0.050*	0,064-1,270*
Cam base circle (radius)	1.869	47,47	1.881	47,78	1.839	46,71
Hardness, cam surface	R_C60	–	R_C64	–	R_C60	–

TORQUE VALUES

	Lb.-Ft.	N·m
Camshaft dowel nuts	80-90	108-122
Thrust bearing bolts	25-30	34-41
Drive gear bolts	70-75	95-102
Camshaft bearing mounting bolts	40-45	54-61
Camshaft bearing assembly bolts	35-40	47-54

*These values will deviate upward from "new" backlash values because of gear tooth wear; values will deviate downward from "new" backlash values when the crankshaft fit in the main frame is rebored.

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